

AD-A206 754

DTIC FILE COPY

②

USAFSAM-TR-88-28

**ELECTRIC HANDPIECES:
TECHNICAL EVALUATION**

**Arlo H. King, Master Sergeant, USAF
Curtis D. Weyrauch, Major, USAF, DC**

December 1988



Final Report for Period September 1987 - September 1988

Approved for public release; distribution is unlimited.

**USAF SCHOOL OF AEROSPACE MEDICINE
Human Systems Division (AFSC)
Brooks Air Force Base, TX 78235-5301**



89 4 07 072

NOTICES


This final report was submitted by personnel of the Dental Investigation Service, Clinical Sciences Division, USAF School of Aerospace Medicine, Human Systems Division, AFSC, Brooks Air Force Base, Texas, under job order NGDATRPR.

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government, nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government, or any agency, contractor, or subcontractor thereof. The views and opinions of the authors expressed herein do not necessarily state or reflect those of the United States Government or any agency, contractor or subcontractor thereof.


When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility or any obligation whatsoever. The fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise in any manner construed, as licensing the holder or any other person or corporation; or as conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.


ARLO H. KING, Master Sergeant, USAF
Project Scientist


PAUL R. PARK, Colonel, USAF, DC
Supervisor


JEFFREY G. DAVIS, Colonel, USAF, MC
Commander

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) USAFSAM-TR-88-28			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION USAF School of Aerospace Medicine		6b. OFFICE SYMBOL (if applicable) USAFSAM/NGD		7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code) Human Systems Division (AFSC) Brooks AFB TX 78235-5301			7b. ADDRESS (City, State, and ZIP Code)		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION USAF School of Aerospace Medicine		8b. OFFICE SYMBOL (if applicable) USAFSAM/NGD		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code) Human Systems Division (AFSC) Brooks AFB TX 78235-5301			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO 87714F	PROJECT NO. NGDA	TASK NO TR
			WORK UNIT ACCESSION NO PR		
11. TITLE (Include Security Classification) Electric Handpieces: Technical Evaluation					
12. PERSONAL AUTHOR(S) King, Arlo H.; Weyrauch, Curtis D.					
13a. TYPE OF REPORT Final		13b. TIME COVERED FROM 87/9 TO 88/9		14. DATE OF REPORT (Yea., Month, Day) 1988, December	
15. PAGE COUNT 18					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP			
06	12		Electric Handpiece		
			Lab Engine		
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
<p>The purpose of this study was to accomplish technical evaluations of six of the most common direct electric-driven handpieces on the market. This will provide assistance to base dental surgeons for selection of units for their particular requirements. The handpieces were compared against criteria developed by USAFSAM evaluators. The user evaluations were performed at USAFSAM and the results are presented herein.</p>					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL Arlo H. King, Master Sergeant, USAF			22b. TELEPHONE (Include Area Code) (512) 536-3502		22c. OFFICE SYMBOL USAFSAM/NGD

DD Form 1473, JUN 85

Previous editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION.....	1
METHODS AND MATERIALS.....	1
RESULTS.....	1
DISCUSSION.....	3
Jelenko Dynamo Plus.....	3
Jelrus Hi-Torque.....	5
NSK Volvere-8.....	6
Osada XL-030.....	8
Teledyne Hanau Emesco 15EHA.....	9
Unitek 738-352.....	11
RECOMMENDATION.....	12
CONCLUSION.....	13

List of Figures

<u>Fig.</u> <u>No.</u>		
1	Jelenko Dynamo Plus.....	4
2	Jelenko Dynamo Plus speed vs. torque curve.....	4
3	Jelrus Hi-Torque.....	5
4	Jelrus Hi-Torque speed vs. torque curve.....	6
5	NSK Volvere-8.....	7
6	NSK Volvere-8 speed vs. torque curve.....	7
7	Osada XL-030.....	8
8	Osada XL-030 speed vs. torque curve.....	9
9	Teledyne Hanau Emesco 15EHA.....	10
10	Teledyne Hanau Emesco 15EHA speed vs. torque curve.....	10
11	Unitek 738-352.....	11
12	Unitek 738-352 speed vs. torque curve.....	12
13	Speed vs. torque curves.....	13

Table No.

1	Electric Handpiece Data.....	2
---	------------------------------	---

iii

Accession For	
MIS	<input checked="" type="checkbox"/>
DISC	<input type="checkbox"/>
Unpublished	<input type="checkbox"/>
Substitution	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	



ELECTRIC HANDPIECES: TECHNICAL EVALUATION

INTRODUCTION

The use of direct electric-driven handpieces in the dental laboratory has become the standard over the use of belt-driven handpieces. The recently developed units have increased power, speed, and features over those of several years ago. The United States Air Force (USAF) Dental Investigation Service (DIS) has undertaken a study to compare the features and capabilities of the most common handpieces on the market. The information in this study can be used by dental clinics to assist in the selection of electric handpieces to meet their particular requirement.

METHODS AND MATERIALS

Handpieces were tested at DIS for physical characteristics, maximum power, and speed. Each unit was placed on a Magtrol Dynamometer using a 4:1 gear reduction ratio. Handpieces were run at maximum revolutions per minute (rpm), torque was gradually applied, and the system was allowed to stabilize to eliminate inertial energy from previous readings. For each handpiece five to six distinct data points were obtained. These points were analyzed by linear regression yielding a correlation coefficient greater than 0.99.

Keywords: Dental equipment (AW)

RESULTS

Table 1 includes the results of the testing completed at DIS. The following list gives the criteria against which each unit was compared.

- o MANUFACTURER: This general information lists the current address and telephone number of each manufacturer or distributor. To ensure the product line has not changed, we recommend the manufacturer be contacted prior to purchase to confirm all specifications and ordering information.
- o MODEL: This general information refers to the current name of the product tested. The manufacturer must be contacted for the current order number.
- o ELECTRICAL REQUIREMENTS: Electrical requirements will vary from one facility to the next. Ensure your electrical capabilities will support a particular handpiece prior to ordering.
- o MAXIMUM RPM: This value is the maximum rpm as measured by DIS. These values may vary slightly from those stated by the manufacturer.
- o HP WEIGHT: All units were weighed on an Ohaus 400 D electronic scale. This weight does not include the weight of the cord which connects the handpiece to the control source.

TABLE 1. ELECTRIC HANDPIECE DATA

MANUFACTURER	MODEL	ELECTRICAL REQUIREMENTS	MAXIMUM RPM	HP WEIGHT	POWER	HP DIAMETER	TYPE OF CONTROL	MANUAL CONTROL	BUR CHANGE	PRICE 1 MAY 88
Jelenko Dental Health Products 199 Business Park Dr Armonk, NY 10504 1-800-431-1785	Dynamo Plus	120 V 50/60 Hz 1240 V 50/60 Hz	34,800	183 g	31.7 w at 17,700 rpm	1.6 cm to 2.5 cm	Bench top power source with foot control	no	twist	\$610.00
Jelrus Dental Prod 2020 Jericho Tpk New Hyde Park L.I., NY 11040 1-800-221-6721	Hi- Torque	120 V 50/60 Hz 1240 V 50/60 Hz	33,800	183 g	23.7 w at 17,600 rpm	1.6 cm to 2.5 cm	Bench top power source with foot control	no	twist	\$581.75
NSK American Corp 101 W. Lions Drive Suite 111 Barrington, IL 60010 312-382-6688	Volvere-8	100 V 50/60 Hz 120 V 50/60 Hz 1220 V 50/60 Hz 1240 V 50/60 Hz	34,000	196 g	28.9 w at 16,750 rpm	1.6 cm to 2.5 cm	Bench top power source with foot control	yes	latch	\$695.00
Osada Electric Co 18243 W. 3rd Street Suite 150 Los Angeles, CA 90048 213-651-0711	XL-030	120 V 50/60 Hz	33,500	192 g	26.9 w at 16,800 rpm	1.5 cm to 2.4 cm	Bench top power source, foot control optional	yes	latch	\$960.00
Teledyne Hanau 80 Sonwil Drive P.O. Box 203 Buffalo, NY 14225 1-800-457-1700 NY 1-800-462-4224	Emesco 15EHA	110 V 50/60 Hz	37,000	264 g	37.5 w at 16,900 rpm	1.8 cm to 2.8 cm	Power source on the floor	no	twist	\$680.00
Unitek Corp 2724 South Pecol Rd Monrovia, CA 91016 1-800-423-4318 CA 1-800-221-2614	730-350 Foot Control Model	110 V 60 Hz	28,000	243 g	33.4 w at 14,750 rpm	1.7 cm to 2.8 cm	Power source on the floor	no	twist	\$835.00

- o POWER: This criterion is the maximum power which the handpiece can generate. Also stated is the rpm at maximum power. While some handpieces will attempt to increase the power as torque is applied, our test methods measured the maximum capability. None of the units tested stalled but rather had a circuit breaker which was tripped.
- o HP DIAMETER: This criterion is the maximum and minimum diameter of the handpiece which is normally held in the hand.
- o TYPE OF CONTROL: The control unit for handpieces is either placed on the bench top or the floor. Units placed on the floor take up less bench space, usually have fewer features, and may be subjected to more abuse. In addition, the electrical cord may also be a problem if electrical outlets are not available below the bench. Units placed on the bench top have more features but may create a problem if bench space is limited. If a foot control is used, additional cords from the control unit to the foot control may present a problem. All units with a manual control are bench-top models.
- o MANUAL CONTROL: Some operators prefer to use a manual control over a variable foot control. A manual rheostat is usually set off the control unit and will operate the handpiece at a given rpm.
- o BUR CHANGE: This criterion is the method used to change burs. Some handpieces will use a latch-type device, and others will require a twisting motion of the handpiece. The latch type is generally easier to use; however, the user must ensure the latch is completely closed prior to operating or the mechanism will fail quickly.
- o PRICE: This general information is the current price as of 1 May 1988. The manufacturer should always be contacted for a current price.

DISCUSSION

Jelenko Dynamo Plus

The Jelenko Dynamo Plus (Fig. 1) is an electric handpiece which features a bench-top control box. On the front of the control box is the "OFF/ON" switch, a reset button, a light for speed indication, and a "FORWARD/REVERSE" switch. The handpiece is capable of producing a maximum of 34,800 rpm, 31.7 W at 17,000 rpm (Fig. 2) and comes with a lightweight telephone-type cord. On the reverse side of the unit is the foot control jack and the fuse. The use of the variable-speed foot control is required as there is no manual control. The handpiece weight is 183 g and does not include the weight of the cord. This handpiece may also be connected to the Jelenko Powerhouse, a high-speed bench lathe. The design of the Dynamo Plus is similar to the Jelrus Hi-Torque.

The sound level of the Jelenko Dynamo Plus is low, and there is sufficient power at all speeds. The handpiece weight is average, and the size is good for most technicians. Changing the bur involves twisting a ring on the handpiece. This procedure is slightly difficult due to the tightness of the ring. The foot pedal is very responsive; however, it did not always stay in place.

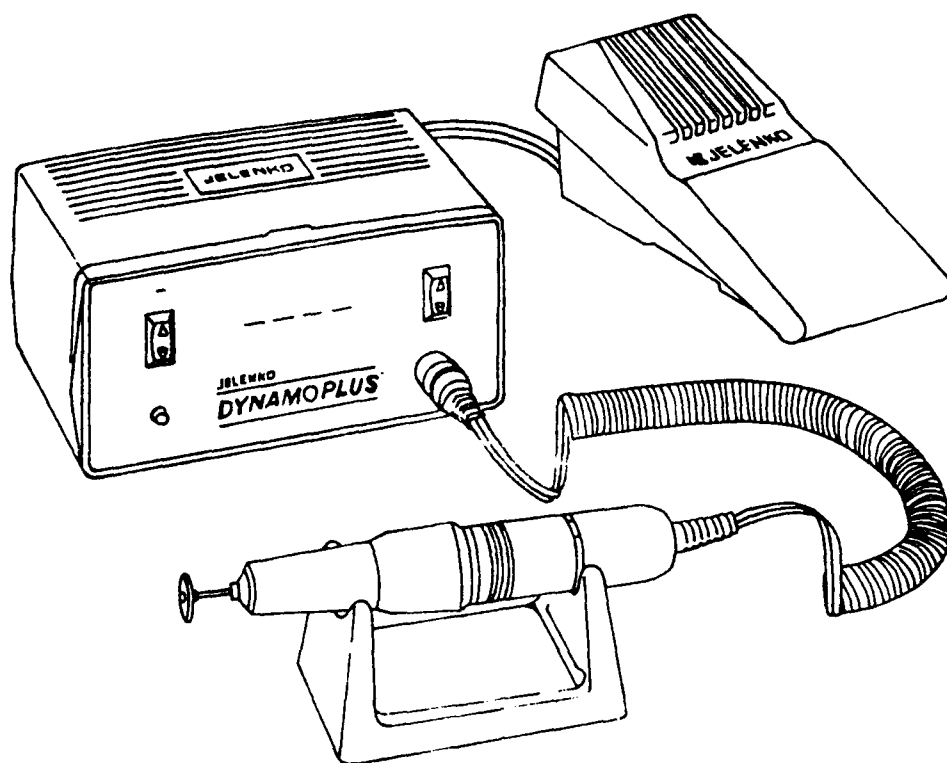


Figure 1. Jelenko Dynamo Plus.

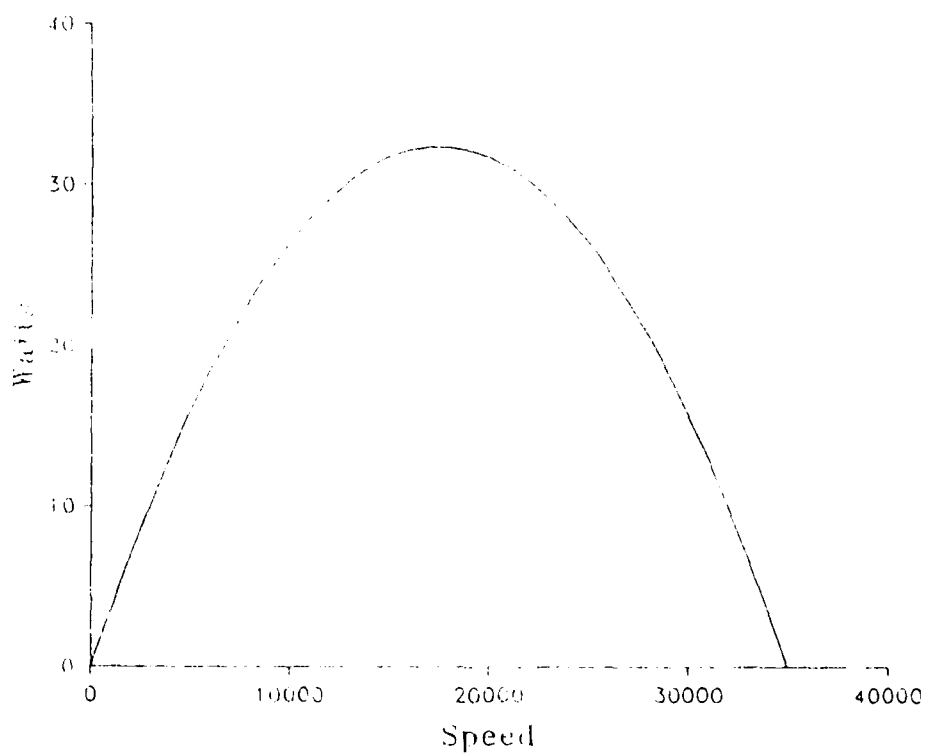


Figure 2. Jelenko Dynamo Plus speed vs. torque curve.

Jelrus Hi-Torque

The Jelrus Hi-Torque (Fig. 3) is an electric handpiece with the control box located on the bench top. On the front of the unit is the "ON/OFF" switch, the "FORWARD/REVERSE" switch, a "RESET" button, a light for speed indication, and the jack for the handpiece cord. The Hi-Torque produces a maximum of 33,800 rpm, 23.7 W at 17,600 rpm (Fig. 4), and comes with a light-weight telephone type cord. The use of the variable-speed foot control is required as there is no manual control. The handpiece weight is 183 g and does not include the weight of the cord. The design of the Jelrus Hi-Torque is similar to the Jelenko Dynamo Plus.

The sound level of the Jelrus Hi-Torque is about average. There is excellent power at low speeds and above average power at high speeds. Handpiece weight is average and balance is excellent. As with the Dynamo Plus, the handpiece size is good; however, the burs are slightly difficult to change due to the tightness of the handpiece ring. The foot pedal is a good size and very responsive; however, there is some problem with the foot pedal staying in place.

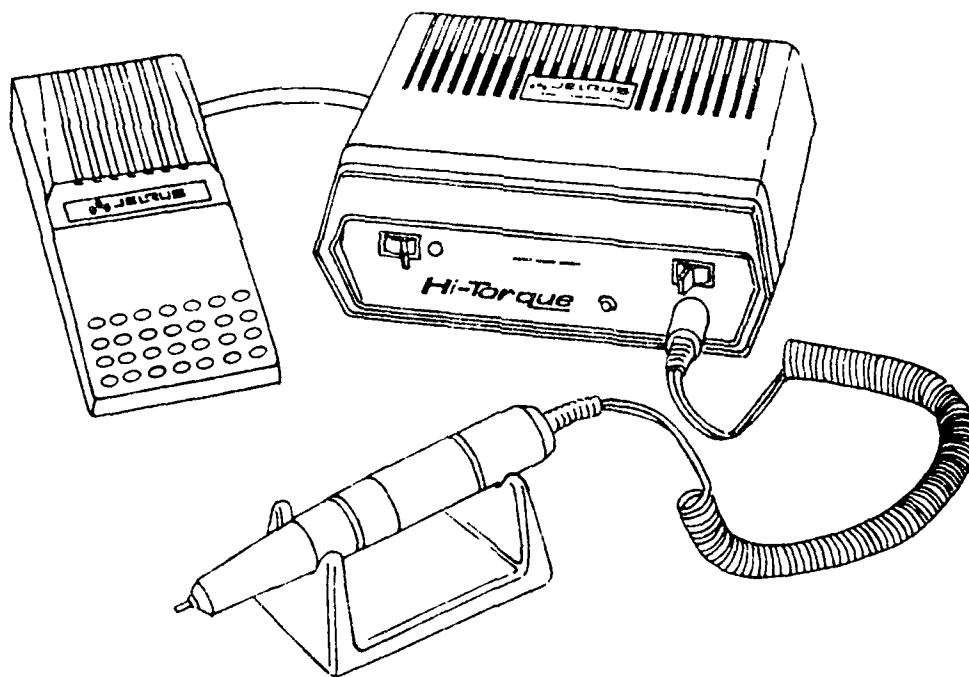


Figure 3. Jelrus Hi-Torque.

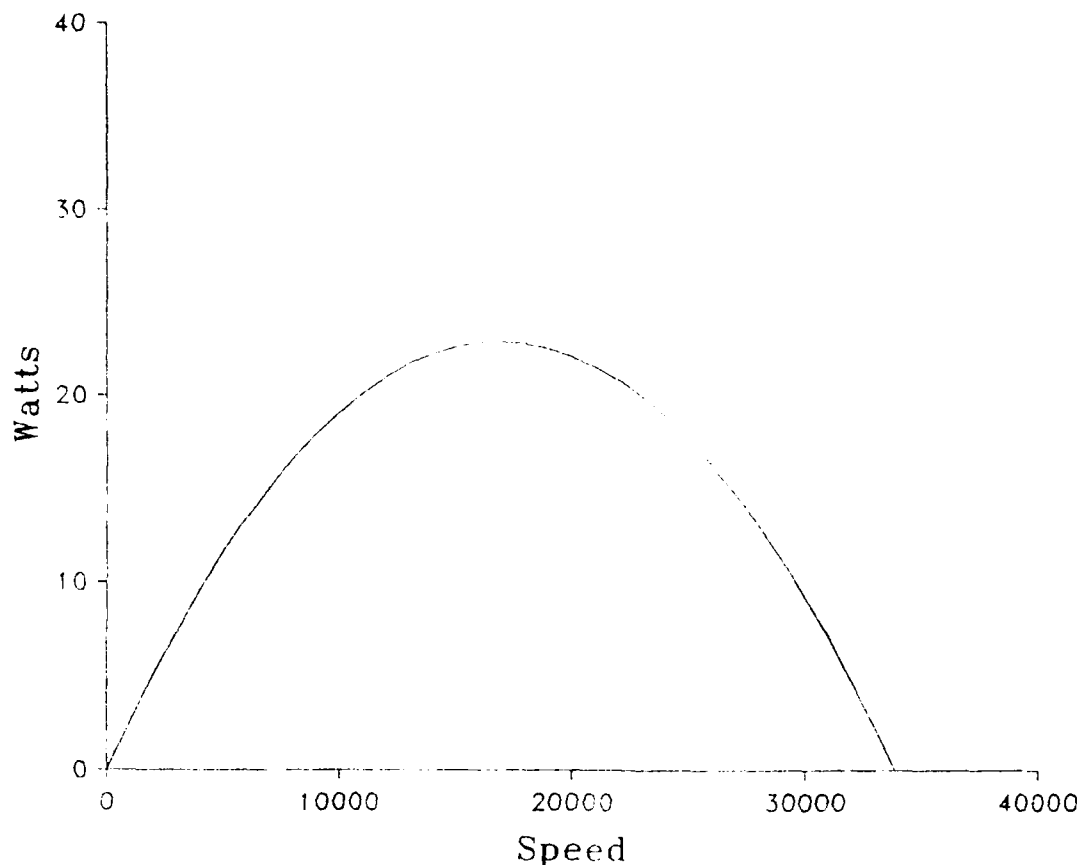


Figure 4. Jelrus Hi-Torque speed vs. torque curve.

NSK Volvere-8

The NSK Volvere-8 (Fig. 5) electric handpiece features a bench-top control box. On the front of the unit is a "FORWARD/REVERSE" switch, a switch for selecting the manual or foot control, and a large dial for setting the desired rpm when using the manual control. The handpiece jack is located on the front of the unit and there is a light which indicates the rpm's. On the back of the unit is the foot control jack, a reset switch, and the fuse. The Volvere-8 is capable of producing a maximum of 34,000 rpm, 28.9 W at 16,750 rpm (Fig. 6). The handpiece weight is 196 g and comes with a latch-type bur changer. The Volvere-8 has an E-Type ISO standard coupling which allows the use of different attachments (purchased separately). The unit will also accept a straight angle (Friction Grip 1:3 Speed Increaser Angle, See DIS Project 87-67) or a contra angle attachment.

The NSK Volvere-8 has excellent power at all speeds to accomplish all tasks. Handpiece weight and balance are above average. The handpiece size and foot control responsiveness is above average. The ability to change burs is excellent due to the latch-type device. However, the user must be sure the latch is completely closed when operating, or the collet will quickly wear out.

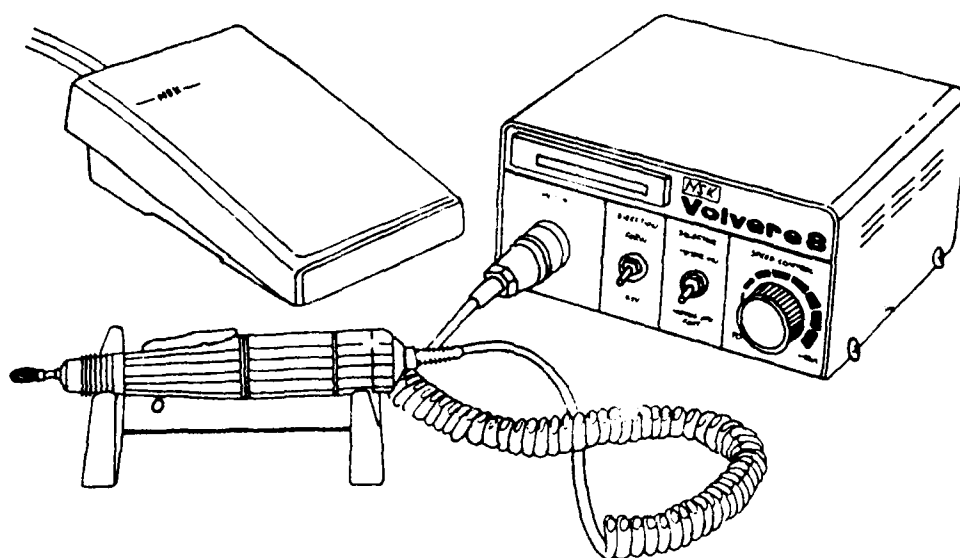


Figure 5. NSK Volvere-8.

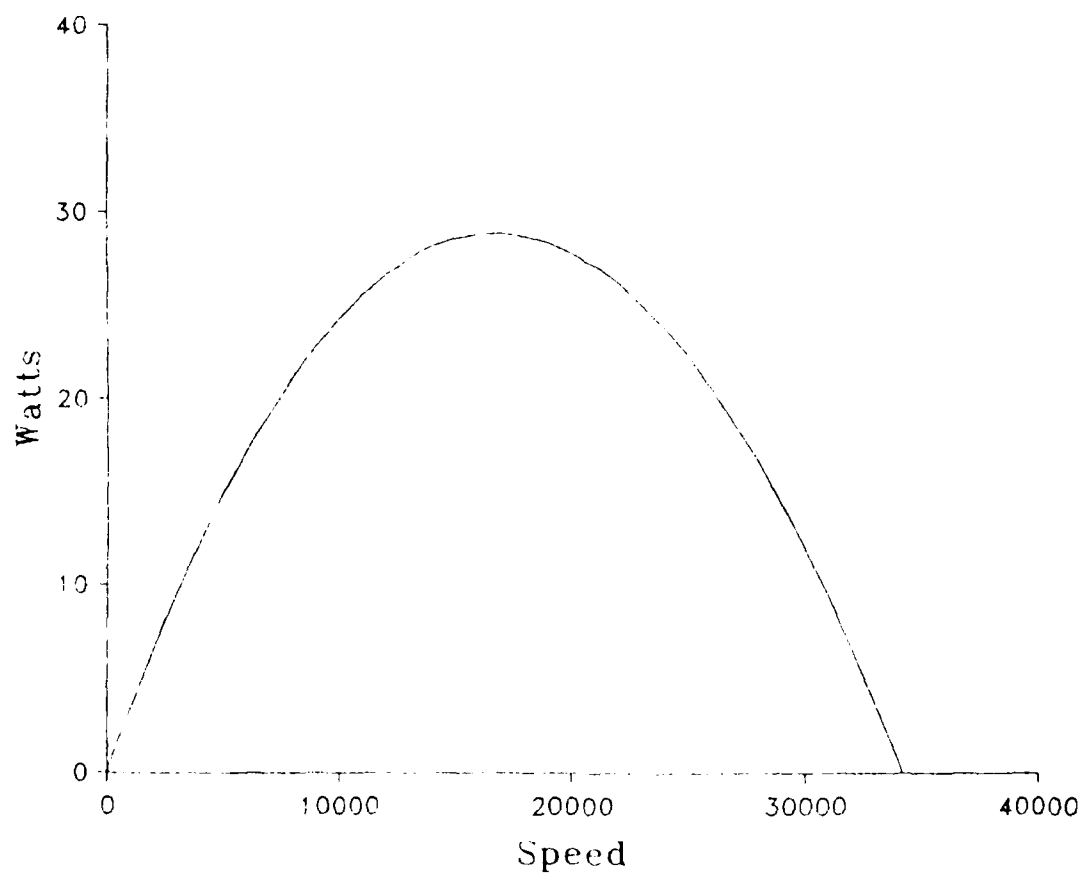


Figure 6. NSK Volvere-8 speed vs. torque curve.

Osada XL-030

The Osada XL-030 (Fig. 7) has the control box located on the bench top. On the front of the unit is the "ON/OFF" switch, a "FORWARD/REVERSE" switch, a slide rheostat for manually setting the rpm's, a "MANUAL/FOOT" switch, and the handpiece jack. On the reverse side of the unit is the reset button and the foot control jack. The XL-030 produces a maximum of 33,500 rpm and 26.9 W at 16,800 rpm (Fig. 8). The handpiece is a latch type, the smallest in size of those tested, and weighs 192 g. This unit has a manual rheostat on the control unit and the variable-speed foot control is an optional accessory.

The sound level of the Osada XL-030 is very low, and power is excellent at high and low speeds. The handpiece size is ideal for individuals who prefer a smaller handpiece. The unit tested had the optional foot control which is above average in responsiveness and stays in place well. The ability to change burs is excellent because of the easy-to-use latch-type device.

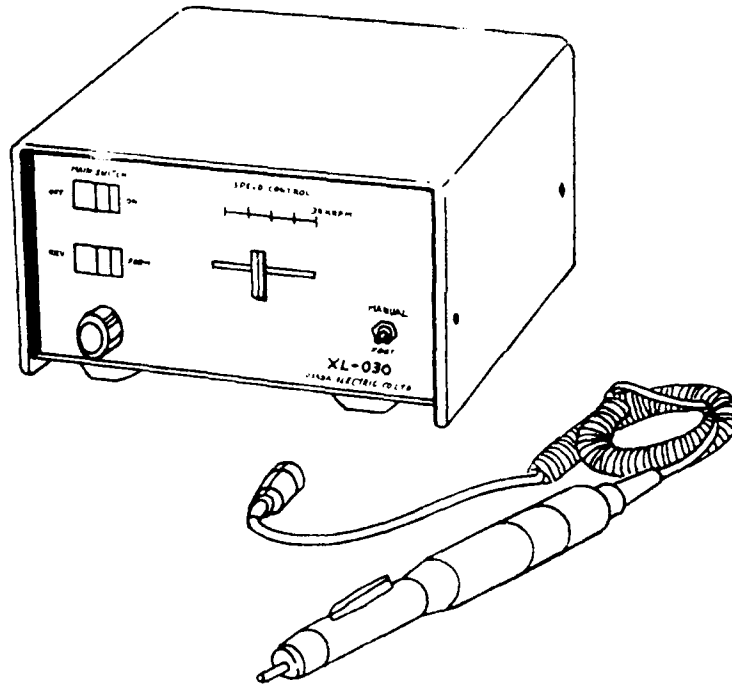


Figure 7. Osada XL-030.

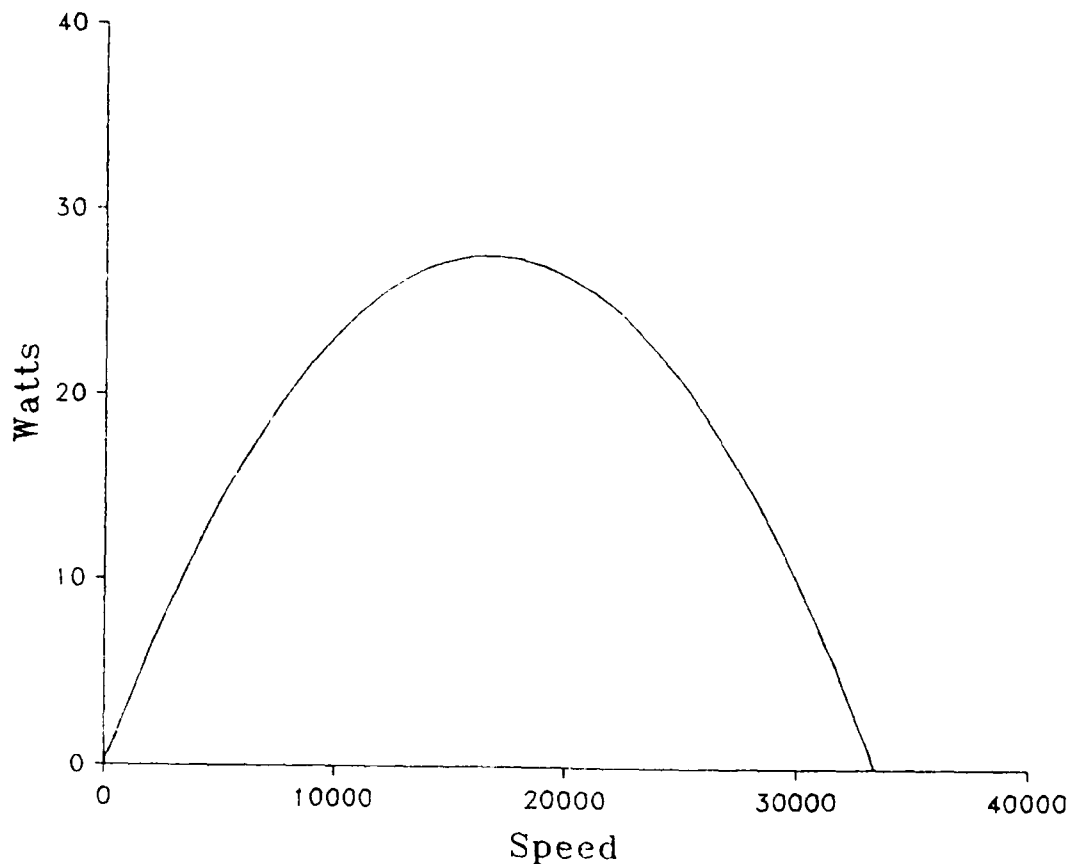


Figure 8. Osada XL-030 speed vs. torque curve.

Teledyne Hanau Emesco 15EHA

The Teledyne Hanau Emesco 15EHA (Fig. 9) is a heavy-duty electric handpiece with the control box located on the floor. On the top of the control box is a "FORWARD/REVERSE" button and on the side of the unit is a reset button. The variable-speed foot control is located on the box and is a lever type. The handpiece can produce a maximum of 37,000 rpm and 37.5 W at 16,900 rpm (Fig. 10). The handpiece weight is 264 g, higher than any others tested. All operation of this unit is through the use of the variable-speed foot control as there is no manual control.

The Emesco 15EHA appears to be an extremely durable and well-made electric handpiece. This unit has exceptional power at all speeds and the foot control is very stationary. The handpiece weight and size are very large as compared to most models, which may cause some technicians to comment on hand fatigue. Because the "FORWARD/REVERSE" button is located on the top of the control box, it may be accidentally depressed, thus causing problems for some operators.

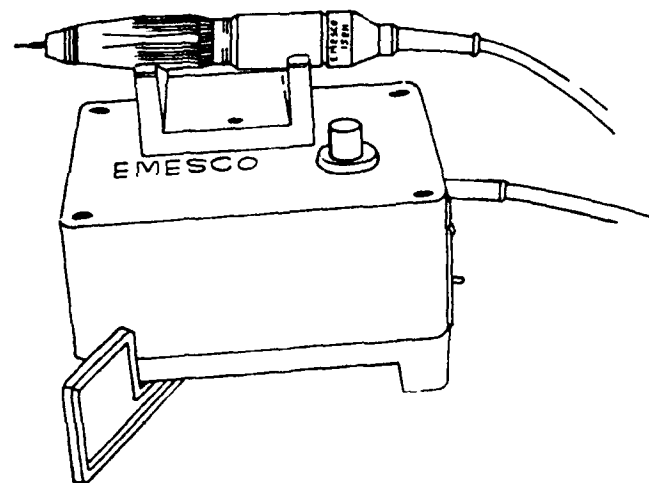


Figure 9. Teledyne Hanau Emesco 15 EHA.

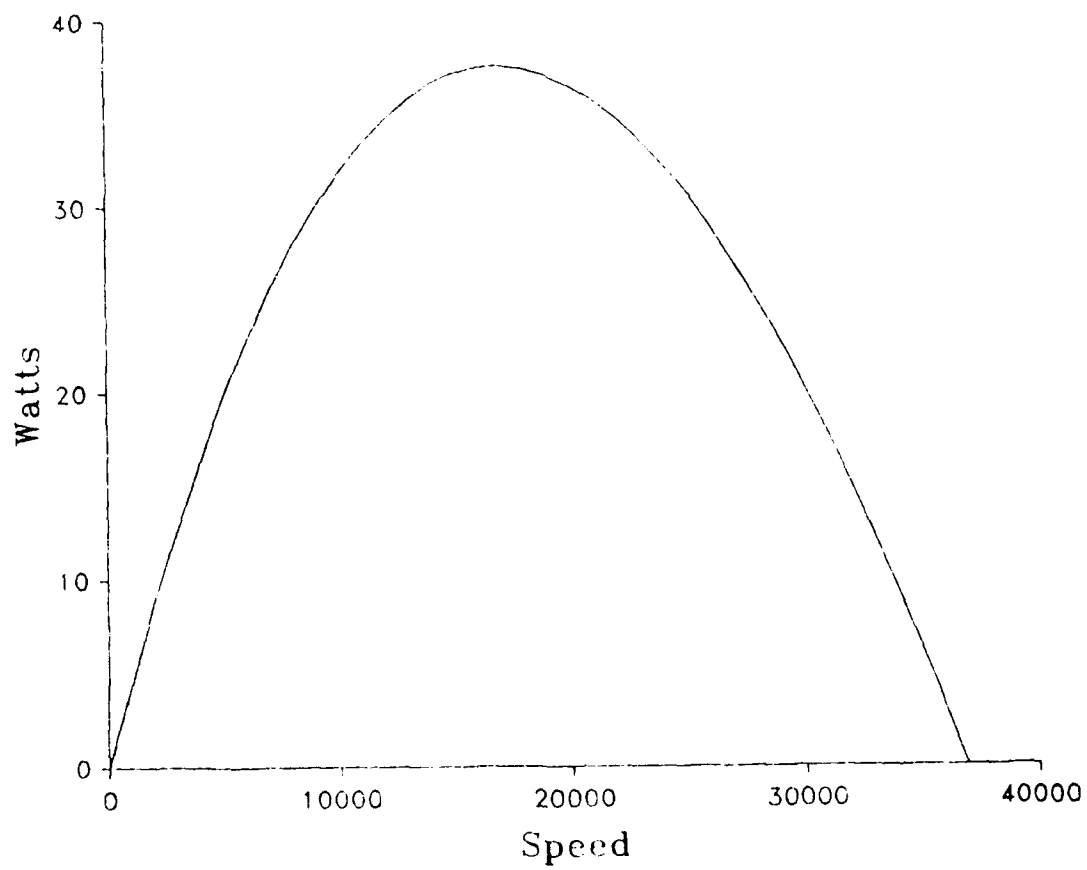


Figure 10. Teledyne Hanau Emesco 15 EHA speed vs. torque curve.

Unitek-738-352

The Unitek 738-352 electric handpiece (Fig. 11) has the control box located on the floor. The "FORWARD/REVERSE" button is located on the top of the unit, and the foot control is a lever type. This unit produces a maximum of 28,000 rpm and 33.4 W at 14,750 rpm (Fig. 12). The handpiece weighs 243 g, and bur removal is accomplished by twisting a ring on the handpiece. This unit may be operated only by the variable-speed foot control. Unitek also markets a similar bench-top model which has a manual rheostat on the control box and a variable-speed foot control.

The Unitek handpiece has excellent power at low and high speeds to accomplish all tasks. Handpiece weight is average, but balance, vibration, and size are above average. The foot control is above average in responsiveness, with most technicians preferring the lever type of control. The ability to change burs is above average, which is aided by the grip of the handpiece.

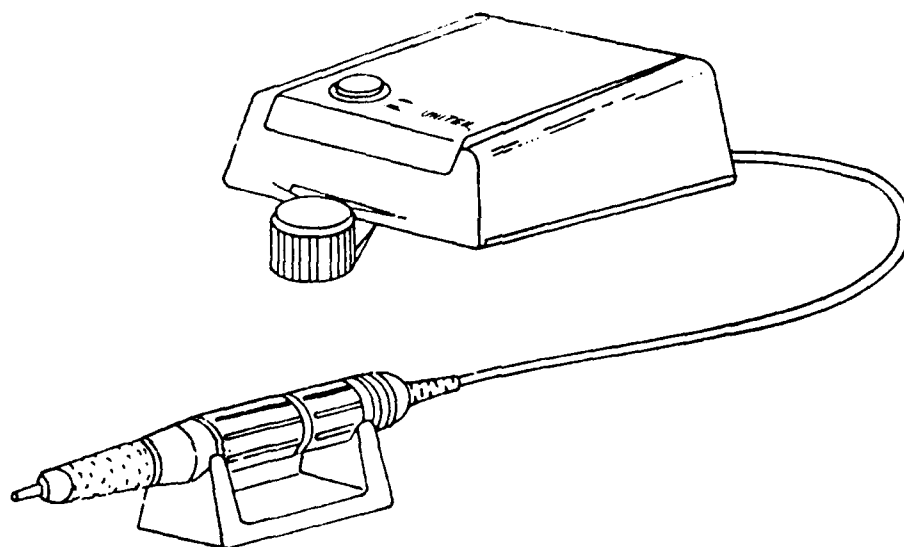


Figure 11. Unitek 738-352.

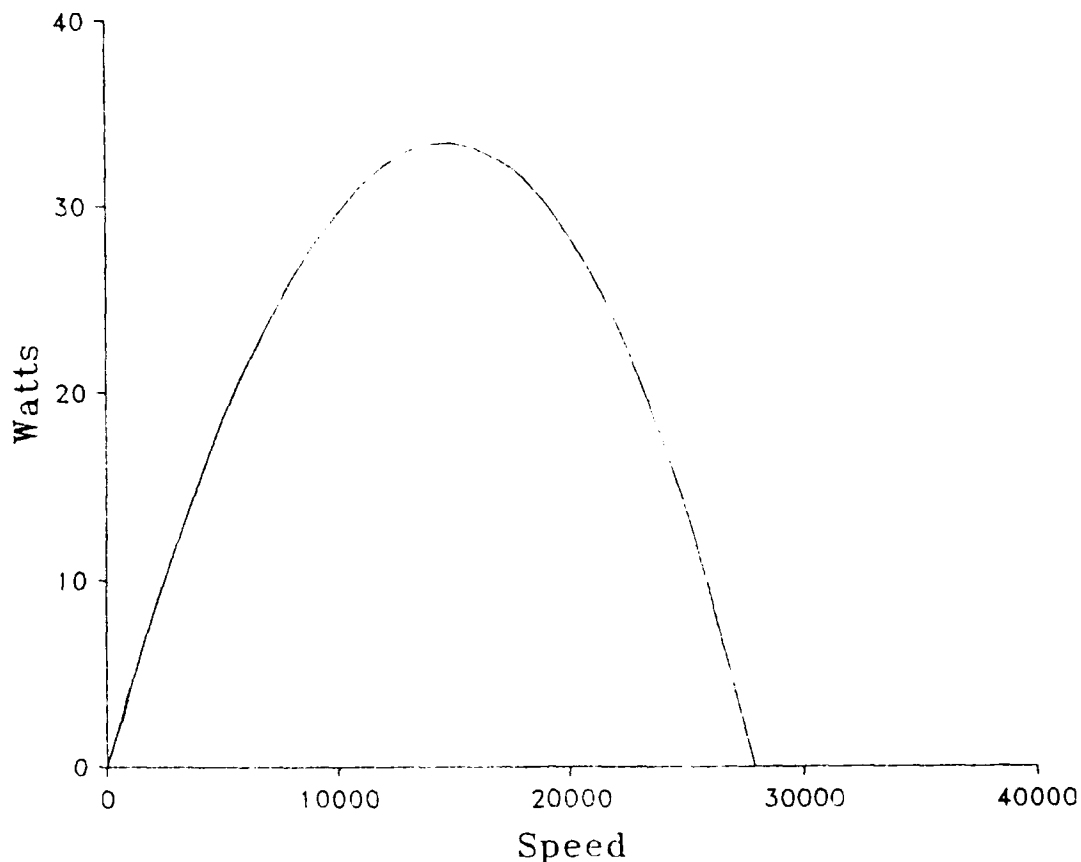


Figure 12. Unitek 738-352 speed vs. torque curve.

RECOMMENDATION

In spite of the difference in speed vs. torque (Fig. 13), all handpieces appeared to have sufficient power at low and high speeds. Handpiece size, weight, and features were more critical.

The design of a dental laboratory and work benches should be considered when purchasing handpieces. If bench space is limited, a floor model such as the Emesco 15E.A or the Unitek 738-352 would work well. (This type works best if there are electrical outlets below the bench.) If bench space is adequate and foot control cords may be run through the bench, the Dynamo Plus, Hi-Torque, Volvere-8, or the XL-030 should be considered. If cords may not be run through the bench, a handpiece with a manual rheostat, such as the Volvere-8 or the XL-030, would work well.

Handpiece size and bur removal method are other features which should be considered in any purchasing decision. Technicians with small hands may prefer the smaller lightweight handpieces. The larger, heavier units were not excessively heavy but may cause hand fatigue for some individuals. In general, the latch type of bur removal is preferred over the ring type. The latch type is simple to use; however, the operator must ensure the latch is completely

closed or the mechanism will quickly wear out. The units which require the operator to twist a ring on the shaft of the handpiece were slightly difficult to use because of the tightness of the ring. This tightness was likely due to the handpiece being new and would loosen slightly with time.

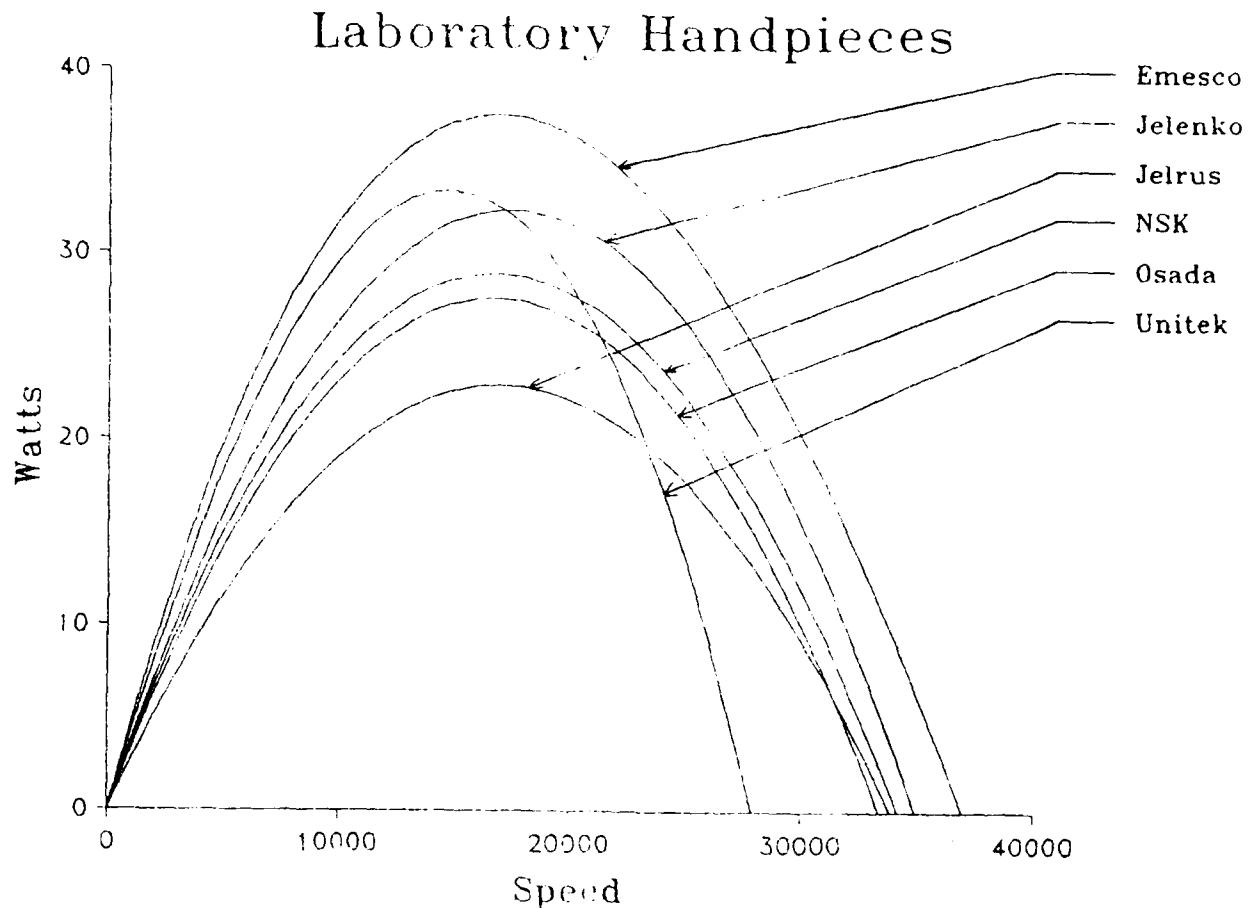


Figure 13. Speed vs. torque curves.

CONCLUSION

All handpieces worked well for their intended purpose. The selection of the proper electric handpiece depends on the respective needs of the operator and the physical design of the work area.

The information provided in this report can be used by base dental surgeons as an aid in purchasing electric handpieces. Any questions should be directed to the U.S. Air Force Dental Investigation Service, USAFSAM/NGD, Brooks AFB, TX 78235-5301, AUTOVON 240-3502, Commercial (512) 536-3502.